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**REQUEST FOR PARTICIPATION IN THE PATENT PROSECUTION HIGHWAY (PPH)  
PROGRAM BETWEEN THE JPO AND THE USPTO**

Application No.:	10588737	First Named Inventor:	Hiromu KAKUYA
Filing Date:	August 8, 2006	Attorney Docket No.:	011050.58088US
Title of the invention:	ENGINE CONTROLLER		

**THIS REQUEST FOR PARTICIPATION IN THE PPH PROGRAM ALONG WITH THE REQUIRED DOCUMENTS MUST BE SUBMITTED VIA EFS-WEB. INFORMATION REGARDING EFS-WEB IS AVAILABLE AT [HTTP://WWW.USPTO.GOV/EFC/EFS\\_HELP.HTML](http://www.uspto.gov/efc/efs_help.html).**

**APPLICANT HEREBY REQUESTS PARTICIPATION IN THE PATENT PROSECUTION HIGHWAY (PPH) PROGRAM AND PETITIONS TO MAKE THE ABOVE-IDENTIFIED APPLICATION SPECIAL UNDER THE PPH PROGRAM.**

The above-identified application (1) validly claims priority under 35 U.S.C. 119(a) and 37 CFR 1.55 to one or more corresponding JPO application(s) or to a PCT application that does not contain any priority claim, or (2) is a national stage entry of a PCT application that does not contain any priority claim.

**The JPO/PCT application number(s) is/are:** PCT/JP04/001334 & JP2005-517603

**The filing date of the JPO/PCT application(s) is/are:** both filed February 9, 2004

**I. List of Required Documents:**

- a. **A copy of the latest JPO office actions (other than "Decision to Grant a Patent") in the above-identified JPO application(s)**

☒ is attached.

☐ is not attached because the JPO application was allowed in a first office action.

\*It is not necessary to submit a copy of the "Decision to Grant a Patent" and an English translation thereof.

- b. **A copy of all claims which were determined to be patentable by the JPO in the above-identified JPO application(s)**

☒ is attached.

- c. **English translations of the documents in a. and b. above along with a statement that the English translations are accurate are attached (if the documents are not in the English language).**

- d. **(1) An information disclosure statement listing the documents cited in the JPO office actions**

☐ is attached.

☐ has already been filed in the above-identified U.S. application on 9/19/08 & 1/15/09

- (2) Copies of all documents (except for U.S. patents or U.S. patent application publications)**

☐ are attached.

☒ have already been filed in the above-identified U.S. application on 9/19/08 & 1/15/09

[Page 1 of 2]

This collection of information is required by 35 U.S.C. 119, 37 CFR 1.55, and 37 CFR 1.102(d). The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS.

## REQUEST FOR PARTICIPATION IN THE PATENT PROSECUTION HIGHWAY (PPH) PROGRAM BETWEEN THE JPO AND THE USPTO

Application No.:	10588737	First Named Inventor:	011050.58088US
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[illegible]

**The petition fee under 37 CFR 1.17(h) as required by 37 CFR 1.102(d) must be paid via EFS-Web (using credit card, authorization to charge a deposit account, or electronic funds transfer).**

Registration Number 25,406

## Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

## DECLARATION

I, Yasushige HASHIMOTO, of HIRAKI & ASSOCIATES, do solemnly and sincerely declare as follows:

1. That I am well acquainted with the English and Japanese languages and am competent to translate from Japanese into English.

2. That I have executed, with the best of my ability, a true and correct translation into English of Notice of Reasons for Rejection, a copy of which I attach herewith.

This 10<sup>th</sup> day of August, 2009

A handwritten signature in cursive script, reading "Yasushige Hashimoto", followed by a horizontal line.

Yasushige HASHIMOTO

## NOTICE OF REASONS FOR REJECTION

Patent Application No.: 2005-517603  
Drafting Date: October 14, 2008  
Mailing Date: October 21, 2008  
Examiner: Makoto ARIGA (3929 3Z00)  
Representative: Yusuke HIRAKI  
Articles Applied: 36 and 37

<<FINAL>>

The captioned application should be rejected for the reasons set forth below. If the applicant wishes to present an argument in response to this notice, however, a written argument should be submitted within 60 days from the mailing date of this notice.

### REASONS

Reason 1. The present application does not comply with the requirements of Article 37 of the Patent Law in respect of the points indicated below.

Reason 2. The present application does not comply with the requirements of Article 36(6)(ii) of the Patent Law as the claims are deficient in respect of the points indicated below.

### NOTE

<Regarding Reason 1>

The invention according to claims 1 and 2 and the invention according to claims 3-12, 15, 16 and 18-24 do not have identical or corresponding special technical features. Thus, the present invention does not comply with the requirements of Article 37 of the Patent Law.

Since the present application does not comply with the requirements of Article 37 of the Patent Law, the invention according to claims other than claims 1, 2, 13, 14 and 17 has not been examined with regard to requirements other than those of Article 37 of the Patent Law.

<Regarding Reason 2>

Claims 1 and 2 recite “an engine controller that performs combustion at stoichiometry, a first combustion region that is richer than stoichiometry, a second combustion region that is leaner than the first combustion region, and a third combustion region that is even leaner than the second combustion region”. However, there is no mention as to what is “stoichiometric,” “rich,” or “lean,” and as a result, it is unclear what kind of regions the respective regions represent.

Therefore, the invention according to claims 1, 2, 13, 14 and 17 is not clear.

Claim 1 recites “pressure is increased” and “intake air mass is increased.” However, their respective standards of comparison are unclear. Thus, the invention is unclear.

Therefore, the invention according to claims 1, 13, 14, and 17 is not clear.

Claim 2 recites “the opening angle of a throttle valve is increased,” “the lift amount of an intake valve is decreased,” and “the lift amount of the intake valve is increased.” However, their respective standards of comparison are unclear. Thus, the invention is unclear.

Therefore, the invention according to claims 2, 13, 14, and 17 is not clear.

Claim 13 recites “the combustion control means.” However, claims 1 and 2 from which it depends do not recite any “combustion control means.” Thus, the invention is unclear.

Therefore, the invention according to claims 13 and 14 is not clear.

Claims 13 and 14 recite “at the time the combustion region number two is passed.” However, there is no mention of how the passing of the combustion region number two is carried out. Thus, the invention is unclear.

Therefore, the invention according to claims 13 and 14 is not clear.

Claim 14 recites “said torque variation.” However, claims 1, 2, and 13 from which it depends do not recite any “torque variation”. Thus, the invention is unclear.

Therefore, the invention according to claim 14 is not clear.

Claim 17 recites “said air mass varying means”. However, claims 1, 2, and 13 from which it depends do not recite any “air mass varying means”. Thus, the invention is unclear.

Therefore, the invention according to claim 17 is not clear.

The “combustion region number two” recited in claims 13 and 14 appears to be an error for “second combustion region”.

In addition, JP Published Patent Application No. 2004-019638 discloses matters relating to the invention according to claims 3 and 4.

#### The Reason This Notice of Reasons for Rejection is Made Final

This is a Notice of Reasons for Rejection notifying only those reasons for rejection necessitated by the amendment that was made in response to the initial Notice of Reasons for Rejection.

整理番号: 発送番号:630200 発送日:平成20年10月21日 1

## 拒絶理由通知書

期 限	20.12.22
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特許出願の番号	特願 2005-517603
起案日	平成20年10月14日
特許庁審査官	有賀 信 3929 3Z00
特許出願人代理人	平木 祐輔 様
適用条文	第36条、第37条

&lt;&lt;&lt;&lt; 最 後 &gt;&gt;&gt;&gt;

この出願は、次の理由によって拒絶をすべきものです。これについて意見がありましたら、この通知書の発送の日から60日以内に意見書を提出してください。

## 理 由

1. この出願は、下記の点で特許法第37条に規定する要件を満たしていない。
2. この出願は、特許請求の範囲の記載が下記の点で、特許法第36条第6項第2号に規定する要件を満たしていない。

## 記

## &lt;理由1について&gt;

・請求項1、2に係る発明と、請求項3—12、15、16、18—24に係る発明とは、同一の又は対応する特別な技術的特徴を有しておらず、この出願は、特許法第37条に規定する要件を満たさない。

この出願は、特許法第37条の規定に違反しているので、請求項1、2、13、14、17以外の請求項に係る発明については特許法第37条以外の要件についての審査を行っていない。

## &lt;理由2について&gt;

・請求項1、2には、「ストイキとストイキよりリッチな第一の燃焼領域と、該第一の燃焼領域よりもリーンな第二の燃焼領域と、該第二の燃焼領域よりも更に



リーンな第三の燃焼領域と、で燃焼を行うエンジンの制御装置であって、」と記載されているが、何が「ストイキ」、「リッチ」、「リーン」であるか記載されておらず、またこの結果、各領域がどのような領域を表すのか不明確となっている。

よって、請求項 1、2、13、14、17に係る発明は明確でない。

・請求項 1 には、「圧力を高め」、「吸入空気量を増量する」と記載されているが、それぞれ比較の基準が不明確であり発明が不明確となっている。

よって、請求項 1、13、14、17に係る発明は明確でない。

・請求項 2 には、「スロットル弁開度を大きくする」、「吸気弁のリフト量を減少させて」、「吸気弁のリフト量を増大させる」と記載されているが、それぞれ比較の基準が不明確であり発明が不明確となっている。

よって、請求項 2、13、14、17に係る発明は明確でない。

・請求項 13 には「前記燃焼制御手段」と記載されているが、引用する請求項 1、2 には「燃焼制御手段」は記載されておらず発明が不明確となっている。

よって、請求項 13、14に係る発明は明確でない。

・請求項 13、14 には、「前記第二燃焼領域通過時において、」と記載されているが、第二燃焼領域の通過がどのように行われるのか記載されておらず発明が不明確となっている。

よって、請求項 13、14に係る発明は明確でない。

・請求項 14 には「前記トルク変動」と記載されているが、引用する請求項 1、2、13 には「トルク変動」は記載されておらず発明が不明確となっている。

よって、請求項 14に係る発明は明確でない。

・請求項 17 には「前記空気量可変手段」と記載されているが、引用する請求項 1、2、13 には「空気量可変手段」記載されておらず発明が不明確となっている。

よって、請求項 17に係る発明は明確でない。

なお、請求項 13、14に記載された「第二燃焼領域」は、「第二の燃焼領域」の誤記と思われる。

また、特開 2004-019638 号公報には、請求項 3、4に係る発明に関連する事項が記載されている。

## 最後の拒絶理由通知とする理由

最初の拒絶理由通知に対する応答時の補正によって通知することが必要になった拒絶の理由のみを通知する拒絶理由通知である。

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## 先行技術文献調査結果の記録

- ・調査した分野      I P C              F 0 2 D    4 1 / 0 0 — 4 1 / 4 0  
   F 0 2 D    4 3 / 0 0 — 4 5 / 0 0  
   F 0 2 D    1 3 / 0 0 — 2 8 / 0 0  
   F 0 2 P      5 / 1 4 5 — 5 / 1 5 5
- ・先行技術文献      特開 2 0 0 2 — 3 3 9 7 7 8 号公報  
   特開平 0 9 — 1 5 8 7 6 7 号公報  
   特開 2 0 0 2 — 0 9 7 9 7 8 号公報  
   特開 2 0 0 3 — 2 7 8 5 8 9 号公報

この先行技術文献調査結果の記録は、拒絶理由を構成するものではありません。

この拒絶理由通知についての問い合わせがあるとき、または、この出願についての面接を希望するときは、以下までご連絡下さい。

特許審査第二部動力機械 有賀 信  
(電話)    0 3 — 3 5 8 1 — 1 1 0 1 (内線 3 3 5 5)

## DECLARATION

I, Yasushige HASHIMOTO, of HIRAKI & ASSOCIATES, do solemnly and sincerely declare as follows:

1. That I am well acquainted with the English and Japanese languages and am competent to translate from Japanese into English.

2. That I have executed, with the best of my ability, a true and correct translation into English of a set of granted claims of Japanese Patent Application No. 2005-517603 filed on February 9, 2004, a copy of which I attach herewith.

This 10<sup>th</sup> day of August, 2009

A handwritten signature in cursive script, reading "Yasushige Hashimoto", written in black ink. The signature is fluid and extends to the right with a long horizontal stroke.

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Yasushige HASHIMOTO

Patent Granted Claims of JP Application No. 2005-517603 (JP Patent No. 4299305)

[Claim 1]

An engine controller configured to perform combustion at air-fuel ratios of mixture gas feeding combustion of stoichiometry, a first combustion region that is richer than stoichiometry, a second combustion region that is leaner than the first combustion region, and a third combustion region that is even leaner than the second combustion region, and to perform combustion region switching from the first combustion region to the third combustion region passing through the second combustion region, as well as combustion region switching from the third combustion region to the first combustion region passing through the second combustion region, the engine controller comprising

switching control means for switching combustion by performing control where, in switching the combustion region from the first combustion region to the third combustion region, the pressure downstream of a throttle valve is increased to more than it was in a state before switching while maintaining intake air mass to a cylinder, and the intake air mass to the cylinder is thereafter increased to more than it was in the state before switching.

[Claim 2]

An engine controller configured to perform combustion at air-fuel ratios of mixture gas feeding combustion of stoichiometry, a first combustion region that is richer than stoichiometry, a second combustion region that is leaner than the first combustion region, and a third combustion region that is even leaner than the second combustion region, and to perform combustion region switching from the first combustion region to the third combustion region passing through the second combustion region, as well as combustion region switching from the third combustion region to the first combustion region passing through the second combustion region, the engine controller comprising

combustion switching control means for switching combustion by performing control where, in switching the combustion region from the first combustion region to the third combustion region, the opening angle of a throttle valve is increased to more than it was in a state before switching while intake air mass to a cylinder is maintained at the state before switching by decreasing the lift amount of an intake valve to less than it was in the state before switching, and the lift amount of the intake valve is thereafter increased to more than the lift amount for maintaining the intake air mass to the cylinder.

[Claim 3]

The engine controller according to claim 1 or claim 2 further comprising an exhaust purifying device that has a function of purifying NO<sub>x</sub> at an air-fuel ratio richer than an air-fuel ratio of stoichiometry, the engine controller further comprising:

NO<sub>x</sub> emission mass estimating means for estimating NO<sub>x</sub> emission mass downstream of the exhaust purifying device online at a time the second combustion region is

passed; torque variation amount estimating means for estimating torque variation amount online at the time the second combustion region is passed; and combustion control means for performing control where the NOx emission mass downstream of the exhaust purifying device at the time the second combustion region is passed is made to be below a predetermined value and the torque variation amount at the time the second combustion region is passed is made to be below a predetermined value based on the estimate value of the NOx emission mass and the estimate value of the torque variation amount.

[Claim 4]

The engine controller according to claim 3, wherein the NOx emission mass estimating means comprises: exhaust purifying device entrance NOx emission mass estimating means for estimating the NOx emission mass at an entrance of the exhaust purifying device at the time the second combustion region is passed based on the air-fuel ratio of the mixture gas feeding combustion, engine r.p.m., engine torque, and the mass of EGR introduced into a combustion chamber or the mass of EGR remaining in the combustion chamber; and a catalyst model for estimating the NOx emission mass at an exit of the exhaust purifying device based on the air-fuel ratio at the entrance of the exhaust purifying device, the temperature of the exhaust purifying device, and the estimated NOx emission mass at the entrance of the exhaust purifying device.

[Claim 5]

The engine controller according to claim 3, wherein the NOx emission mass estimating means estimates the NOx emission mass downstream of the exhaust purifying device at the time of combustion region switching by accumulating over a period of T1 the NOx emission masses calculated over periods of T2, where T1 is a period required for the combustion region switching, and T2 is a period that is sufficiently shorter than T1.

[Claim 6]

The engine controller according to claim 3, further comprising an air-fuel ratio sensor for detecting NOx concentration in exhaust gas upstream or downstream of the exhaust purifying device, wherein the NOx emission mass estimating means adjusts parameters for estimating the NOx emission mass based on the output of the air-fuel ratio sensor.

[Claim 7]

The engine controller according to claim 3, wherein the torque variation amount estimating means estimates the torque variation amount based on the mass of fuel supply and the engine r.p.m. at the time the second combustion region is passed.

[Claim 8]

The engine controller according to claim 3, wherein the torque variation amount estimating means causes the intake air mass to be changed by changing the opening angle of the throttle valve within a predetermined time at the time of the combustion region switching, and, in so doing, based on a torque variation part that occurs due to a fuel supply mass correction that is performed to compensate for a time delay in the change of the intake air

mass in response to the change in the throttle valve, estimates the torque variation amount.

[Claim 9]

The engine controller according to claim 8, wherein the torque variation amount estimating means retards the ignition timing at the time of the combustion region switching, and, based on a value that is obtained by subtracting a torque variation part that occurs due to the retarding of the ignition timing from the torque variation part that occurs due to the fuel supply mass correction, estimates the torque variation amount.

[Claim 10]

The engine controller according to claim 3, further comprising a torque sensor for detecting engine torque, wherein the torque variation amount estimating means adjusts parameters for estimating the torque variation amount based on the output of the torque sensor.

[Claim 11]

The engine controller according to claim 3, wherein the combustion control means corrects a fuel supply mass so as to change the air-fuel ratio of the mixture gas feeding combustion within a predetermined time if, at the time the second combustion region is passed, a response delay of the air-fuel ratio of the mixture gas feeding combustion in relation to a change in a target air-fuel ratio exceeds a predetermined value.

[Claim 12]

The engine controller according to claim 11, wherein the combustion control means is configured to suppress torque variation by retarding the ignition timing if torque variation occurs due to the correction of the fuel supply mass at the time the second combustion region is passed.

[Claim 13]

The engine controller according to claim 6, further comprising: an exhaust system model for estimating the air-fuel ratio at an entrance of the exhaust purifying device based on the air-fuel ratio of the mixture gas, the engine r.p.m., and the engine torque at the time the second combustion region is passed; and an exhaust system inverse model for estimating the air-fuel ratio of the mixture gas from the air-fuel ratio at the entrance of the exhaust purifying device that is estimated by the exhaust system model, wherein the combustion control means changes the air-fuel ratio of the mixture gas based on the exhaust system inverse model if the time it takes to pass through the second combustion region exceeds a predetermined value.

[Claim 14]

The engine controller according to claim 13, wherein parameters of the exhaust system inverse model are adjusted based on the output of the air-fuel ratio sensor.

[Claim 15]

The engine controller according to claim 3, wherein the exhaust purifying device comprises a lean NOx catalyst.

[Claim 16]

The engine controller according to claim 15, wherein the second combustion region is defined as an air-fuel ratio region comprising stoichiometry and in which the NOx storage efficiency of the lean NOx catalyst exceeds a predetermined value.

[Claim 17]

The engine controller according to claim 15, wherein the third combustion region is defined as an air-fuel ratio region that is leaner than an air-fuel ratio at which the NOx storage efficiency of the lean NOx catalyst exceeds a predetermined value.

[Claim 18]

The engine controller according to claim 3, wherein the engine comprises a compression ignition engine, and the exhaust purifying device comprises a three-way catalyst.

[Claim 19]

The engine controller according to claim 18, wherein the second combustion region is defined as an air-fuel ratio region comprising stoichiometry and in which the NOx concentration at an exit of the combustion chamber drops below a predetermined value.

[Claim 20]

The engine controller according to claim 18, wherein the third combustion region is defined as an air-fuel ratio region that is leaner than an air-fuel ratio at which the NOx concentration at an exit of the combustion chamber drops below a predetermined value.

整理番号:1103015791 特願2005-517603

提出日:平成20年12月22日

1

【書類名】 手続補正書  
【整理番号】 1103015791  
【提出日】 平成20年12月22日  
【あて先】 特許庁長官 殿  
【事件の表示】  
【出願番号】 特願2005-517603  
【補正をする者】  
【識別番号】 000005108  
【氏名又は名称】 株式会社日立製作所  
【代理人】  
【識別番号】 100091096  
【弁理士】  
【氏名又は名称】 平木 祐輔  
【発送番号】 630200

## 【手続補正1】

【補正対象書類名】 特許請求の範囲

【補正対象項目名】 全文

【補正方法】 変更

## 【補正の内容】

【書類名】 特許請求の範囲

## 【請求項1】

燃焼に供される混合気空燃比がストイキとストイキよりリッチな第一の燃焼領域と、該第一の燃焼領域よりもリーンな第二の燃焼領域と、該第二の燃焼領域よりも更にリーンな第三の燃焼領域と、で燃焼を行い、前記第一の燃焼領域から前記第二の燃焼領域を通過して前記第三の燃焼領域への燃焼領域切換、及び、前記第三の燃焼領域から前記第二の燃焼領域を通過して前記第一の燃焼領域への燃焼領域切換を行うようにされたエンジンの制御装置であって、

前記第一の燃焼領域から前記第三の燃焼領域に燃焼領域を切換える際に、シリンダへの吸入空気量を維持しつつスロットル弁の下流の圧力を切換前の状態よりも高め、その後に、前記シリンダへの吸入空気量を切換前の状態よりも増量する制御を行うことで燃焼を切換える切換制御手段を備えていることを特徴とするエンジンの制御装置。

## 【請求項2】

燃焼に供される混合気空燃比がストイキとストイキよりリッチな第一の燃焼領域と、該第一の燃焼領域よりもリーンな第二の燃焼領域と、該第二の燃焼領域よりも更にリーンな第三の燃焼領域と、で燃焼を行い、前記第一の燃焼領域から前記第二の燃焼領域を通過して前記第三の燃焼領域への燃焼領域切換、及び、前記第三の燃焼領域から前記第二の燃焼領域を通過して前記第一の燃焼領域への燃焼領域切換を行うようにされたエンジンの制御装置であって、

前記第一の燃焼領域から前記第三の燃焼領域に燃焼領域を切換える際に、スロットル弁開度を切換前の状態よりも大きくすると共に、吸気弁のリフト量を切換前の状態よりも減少させてシリンダの吸入空気量を切換前の状態に維持させ、その後に、該吸気弁のリフト量をシリンダの吸入空気量を維持するためのリフト量よりも増大させる制御を行うことで燃焼を切り換える燃焼切換制御手段を備えることを特徴とするエンジンの制御装置。

## 【請求項3】

空燃比がストイキよりリッチな空燃比でNO<sub>x</sub>を浄化する機能を持つ排気浄化装置を備えた前記エンジンの制御装置であって、

前記第二の燃焼領域通過時における前記排気浄化装置下流のNO<sub>x</sub>排出量をオンラインで推定するNO<sub>x</sub>排出量推定手段と、前記第二の燃焼領域通過時におけるトルク変動量をオンラインで推定するトルク変動量推定手段と、前記NO<sub>x</sub>排出量推定値及び前記トルク変動量推定値に基づいて、前記第二の燃焼領域通過時における前記排気浄化装置下流のN



NO<sub>x</sub>排出量を所定値以下、かつ、前記第二の燃焼領域通過時におけるトルク変動量を所定値以下とする制御を行う燃焼制御手段と、を備えていることを特徴とする請求項1又は2に記載のエンジンの制御装置。

【請求項4】

前記NO<sub>x</sub>排出量推定手段は、燃焼に供される混合気の空燃比、エンジン回転数、エンジントルク、及び燃焼室に導入されたEGR量もしくは燃焼室内に残留するEGR量に基づいて、前記第二の燃焼領域通過時における前記排気浄化装置入口のNO<sub>x</sub>排出量を推定する排気浄化装置入口NO<sub>x</sub>排出量推定手段と、前記排気浄化装置入口の空燃比、前記排気浄化装置の温度、及び前記排気浄化装置入口の推定NO<sub>x</sub>排出量に基づいて、前記排気浄化装置出口のNO<sub>x</sub>排出量を推定する触媒モデルと、を備えていることを特徴とする請求項3に記載のエンジンの制御装置。

【請求項5】

前記NO<sub>x</sub>排出量推定手段は、前記燃焼領域切換に要する期間をT1とし、該期間T1よりも十分に短い期間をT2として、該期間T2毎に演算されるNO<sub>x</sub>排出量を前記期間T1だけ積算することにより、前記燃焼領域切換時の前記排気浄化装置下流のNO<sub>x</sub>排出量を推定することを特徴とする請求項3に記載のエンジンの制御装置。

【請求項6】

前記排気浄化装置上流側又は下流側において排気ガス中のNO<sub>x</sub>濃度を検出する空燃比センサを備え、前記NO<sub>x</sub>排出量推定手段は、前記空燃比センサの出力に基づいて、前記NO<sub>x</sub>排出量を推定する際のパラメータを調整することを特徴とする請求項3に記載のエンジンの制御装置。

【請求項7】

前記トルク変動量推定手段は、前記第二の燃焼領域通過時における燃料供給量及びエンジン回転数に基づいて、前記トルク変動量を推定することを特徴とする請求項3に記載のエンジンの制御装置。

【請求項8】

前記トルク変動量推定手段は、前記燃焼領域切換時に、所定時間内でスロットル弁の開度を変化させて前記吸入空気量を変化させ、その際、前記スロットル弁の変化に対する前記吸入空気量の変化の時間遅れを補償するために行われる燃料供給量補正に起因して発生するトルク変動分に基づいて、前記トルク変動量を推定することを特徴とする請求項3に記載のエンジンの制御装置。

【請求項9】

前記トルク変動量推定手段は、前記燃焼領域切換時に、点火時期をリタードさせ、その点火時期をリタードさせたことに起因して発生するトルク変動分を、前記燃料供給量補正に起因して発生するトルク変動分から減じた値に基づいて、前記トルク変動量を推定することを特徴とする請求項8に記載のエンジンの制御装置。

【請求項10】

エンジントルクを検出するトルクセンサを備え、前記トルク変動量推定手段は、前記トルクセンサの出力に基づいて、前記トルク変動量を推定する際のパラメータを調整することを特徴とする請求項3に記載のエンジンの制御装置。

【請求項11】

前記燃焼制御手段は、前記第二の燃焼領域通過時において、目標空燃比の変化に対する、燃焼に供される混合気の空燃比の応答遅れが所定値以上となる場合、前記燃焼に供される混合気の空燃比を所定時間内で変化させるように燃料供給量を補正することを特徴とする請求項3に記載のエンジンの制御装置。

【請求項12】

前記燃焼制御手段は、前記第二の燃焼領域通過時において、燃料供給量の補正によってトルク変動が発生した際には、点火時期をリタードさせて前記トルク変動を抑制するようにされていることを特徴とする請求項11に記載のエンジンの制御装置。

【請求項13】

前記第二の燃焼領域通過時における混合気の空燃比、エンジン回転数、及びエンジントルクに基づいて、前記排気浄化装置入口の空燃比を推定する排気系モデルと、該排気系モデルにより推定された前記排気浄化装置入口の空燃比から前記混合気の空燃比を推定する排気系逆モデルと、を備え、前記燃焼制御手段は、前記第二の燃焼領域を通過する期間が所定値以上である場合に、前記排気系逆モデルに基づいて、前記混合気の空燃比を変化させることを特徴とする請求項6に記載のエンジンの制御装置。

【請求項14】

前記空燃比センサの出力に基づいて、前記排気系逆モデルのパラメータを調整することを特徴とする請求項13に記載のエンジンの制御装置。

【請求項15】

前記排気浄化装置は、リーンNO<sub>x</sub>触媒であることを特徴とする請求項3に記載のエンジンの制御装置。

【請求項16】

前記第二の燃焼領域は、ストイキ及び前記リーンNO<sub>x</sub>触媒のNO<sub>x</sub>貯蔵効率が所定値以上となる空燃比領域と規定されていることを特徴とする請求項15に記載のエンジンの制御装置。

【請求項17】

前記第三の燃焼領域は、前記リーンNO<sub>x</sub>触媒のNO<sub>x</sub>貯蔵効率が所定値以上となる空燃比よりリーンな空燃比領域と規定されていることを特徴とする請求項15に記載のエンジンの制御装置。

【請求項18】

前記エンジンが圧縮着火エンジンであり、前記排気浄化装置が三元触媒であることを特徴とする請求項3に記載のエンジンの制御装置。

【請求項19】

前記第二の燃焼領域は、ストイキ及び前記燃焼室の出口におけるNO<sub>x</sub>濃度が所定値以下となる空燃比領域と規定されていることを特徴とする請求項18に記載のエンジンの制御装置。

【請求項20】

前記第三の燃焼領域が、前記燃焼室の出口におけるNO<sub>x</sub>濃度が所定値以下となる空燃比よりリーンな空燃比領域と規定されていることを特徴とする請求項18に記載のエンジンの制御装置。